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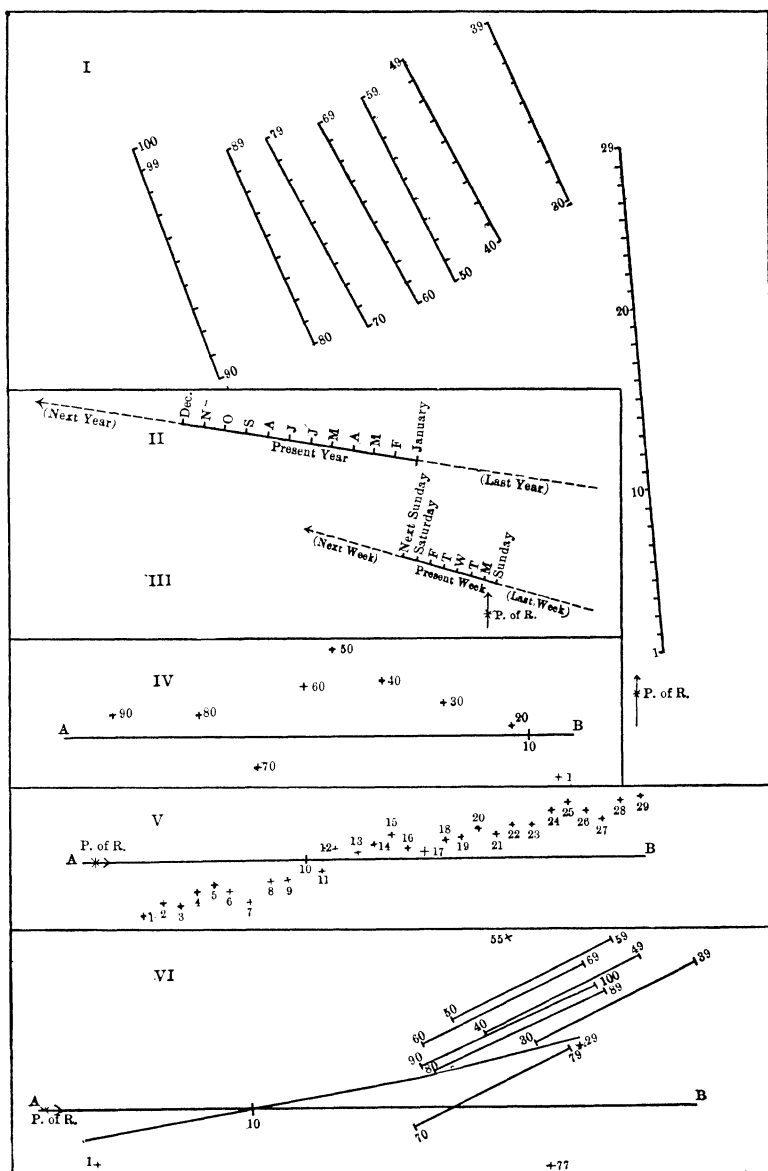
FIXED VISUALIZATION: THREE NEW FORMS.

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In making a record of the following case, which was first reported at the New Haven meeting of the American Psychological Association, the language used by the subject in verbal description is selected from the stenographic records. The language aids the reader to appreciate the manner in which the forms are experienced and apperceived by the subject. The case is of interest on account of the variety of forms, their permanency and certain uniformities characterizing them.¹ The diagrams, I to VI, in the chart on page 356, representing selected features of the forms for numbers, days, and months, will give fixity to the descriptions. The diagrams are reproductions of the "geography" of the various units in each form as they were located on a large scale by the subject. Diagram I shows the number form, diagram II, the month form, and diagram III, the day form in the horizontal plane. All the numbers from one to one hundred appear in their serial places, as indicated in I. The relative locations of the three forms, as experienced by the subject, can be ascertained by mentally superimposing the point of regard in II-III upon the point of regard in I. Although the day and month forms are never visualized simultaneously, diagrams II and III have been sketched with the same point of regard, so as readily to indicate their points of contrast and agreement.

Selected details of the number form are sketched in diagrams IV-VI. IV is a vertical section, showing the elevation of the respective numbers indicated, AB being the horizontal plane of vision. V is designed to represent the elevation in the series from one to twenty-nine. The remaining groups of tens repeat the variations in elevation thrice indicated in V, but at a greater inclination, are represented in VI. I may add that the original sketches were repeatedly verified by the subject. (In VI, the inclines of all groups from thirty to ninety should be parallel. It has been impossible to secure the geometrical accuracy in the case of seventy, eighty, and ninety in VI and IV, which tends to be a feature in the other localizations.)

¹ Descriptions of additional forms are to be found in this *Journal*, Vol. V, 1892-1893, pp. 265 ff., 439 ff.; Vol. VIII, 1896-1897, pp. 506 ff.



I. THE NUMBER FORM.

The number-form appears to the subject in a half fan-like radiation, extending forward and to the left of the mental point of regard. This composite feature appeared gradually from the following description: "I look down to one, which is very near [me and slightly to the right. Two is farther away and above one. Three is lower than two, but not so low as one. Four is sharply above three. Five is higher than four, and beyond four. Six goes down below five. Seven is more below six than six is below five; in fact, seven seems lower than one though it is beyond one. Eight rises sharply from seven, more sharply than four is from three. In regard to nine, it is difficult to tell whether it is above or below eight. I think it is very slightly below eight, being on the incline. Ten is above nine, and is directly opposite the mental point of regard, in the horizontal plane. Eleven is a little below ten. Twelve is above eleven. Thirteen is a little below twelve. Fourteen is above thirteen. Fifteen is above fourteen, being quite high, so that I have to look up to it. Sixteen is below fourteen. I never think of sixteen being on a level with thirteen, but think of a number only in relation to the one preceding and the one following it. Seventeen is below sixteen. Seven is the lowest number in the first series of ten. This is true of all the tens. The series of seventy is the lowest in the whole series, seventy-seven being the lowest of all the numbers. Eighteen rises sharply above seventeen. Nineteen is to eighteen as nine is to eight, but beyond it. I think of it as lower, but know it is higher on account of the incline. Twenty rises above nineteen. Twenty-one is a little lower. The varying positions of the numbers from twenty-one to twenty-nine repeat the variations in the series from one to ten."

"The numbers fall into groups as follows. One to twenty-nine are in a continuous direction. Twenty-nine seems about twelve feet distant from me. The next group includes thirty to thirty-nine, and lies to the left of the twenties. Thirty is about as near me as twenty-seven. The numbers in this group seem to bank themselves together in an incline that is steeper than the incline occupied by one to twenty-nine. The next group includes forty to forty-nine, and lies to the left of the thirties. These numbers are arranged in a manner similar to those in the thirty group. The remaining groups include the fifties, the sixties, the seventies, the eighties, and the nineties, one hundred being beyond ninety-nine, each group being arranged similar to the thirties."

"The numbers in the twenty series stand out as distinctly as the first few numbers. I do not think of their size, but only

of their locations. I see these numbers as we ordinarily write them, that is, the numbers up to twenty. Though I can put in a figure, I usually think of the word 'seven.' The word 'one' is very short in comparison with the word 'sixteen.' From twenty to twenty-nine the numbers seem to appear; in the thirty group the words."

"The series one to twenty-nine seems darker than the surrounding space. The words are not illuminated. The word itself is darker. The space around it seems gray. There is no difference in the shading from one to one hundred. There is no illumination; all seems dark. In the side series I see nothing at all; that region does not appear except when I try to picture it." (Later analytical experience with the form revealed that the whole form could be made to stand out at once.)

"I never find, for example, a number from one to twenty-nine missing; it always appears. The space comes instantly. When any one says 'twenty-nine dollars,' my mind goes immediately to the twenty-nine in that space. I cannot transpose the numbers, and a number never seems out of place. I cannot put seven where sixteen is, nor move forty to where thirty is. I seem to have no control over the arrangement of the whole series, nor over any number in the series. If I try to look down the right side of the thirties or the forties, my mind does not seem able to view them in that relation at all."

"I put thirty a little higher than thirty-one, and forty a little higher than forty-one, and so on throughout the remaining groups. Thirty is the lowest one in that incline; it occupies the lowest plane. Thirty-one is seen lower than thirty, dropping a little, but *is* higher, being on the incline. Thirty *is* about on a level with twenty-nine. I never think of looking past thirty-nine to forty. Forty never gets in the way of thirty-nine, the latter being a little lower than the former."

"Forty is higher than any in the twenty series. The numbers from forty-one to forty-nine are just the same in their relations to each other as the numbers in the thirty series. Forty-nine is just as much higher than thirty-nine as forty is higher than thirty, both series having the same inclination. The fifty series is higher than the forty, the same as five is higher than four. The sixty series is below the fifty quite decidedly; I think it is below the forty. I cannot compare the elevations of thirty and sixty. I think I can look at the fifties and the sixties from either side. If I were not thinking about it, I might be able to tell better. Seventy is to sixty just about as seven is to six, being lower. The seventies are much lower than seven, the lowest point in the entire form being seventy-seven. Fifty-five is the highest number. Eighty is a little

higher than seventy, and ninety is a little higher than eighty. I look upon one to twenty-nine, the thirties, and the forties from the left side, and on the nineties, eighties, and seventies from the right side of the series. The fifties and sixties seem to be almost directly in the line of vision."

"The numbers seem to occupy spaces, which I would represent by a parallelogram, measuring about $\frac{5}{8}$ ths by $\frac{1}{8}$ th inches for the larger numbers, and $\frac{3}{8}$ ths by $\frac{1}{8}$ th for the smaller numbers."

A time-test revealed that the successive numbers "rose" in the mind very rapidly. Viewing each number successively from one to one hundred, omitting none, required an average interval of only twenty-eight seconds. A similar test on a number of adults without any number form required intervals varying from seventy-three to ninety-two seconds. The subject required thirty-two seconds to count the whole series, that is, mentally saying the words while following the numbers. This proved to be the approximate average for the other adults.

"Whenever I perceive a number written on the blackboard, I see it in this series if it is below one hundred. I never confuse the numbers on the board with the numbers in my mind. I cannot read a newspaper account containing numbers less than one hundred so rapidly as not to see the numbers in the form. If, on the other hand, I wanted to remember a special thing, such as in shopping, if I wished to buy two spools of silk and five yards of ribbon, I would not use these mental numbers in any way. They would not help me to remember. Whenever a mistake is made in change, for example, the series never helps me out. Once I could remember numbers in general statistics quite well, but not now. I was always very quick and accurate in arithmetic, and learned it very fast."

"I have not noticed any tendency on the part of the form to change during the last few years. In fact, it is permanent, and could not change. In thinking of thirty, or forty, I would not feel uncomfortable if all the other numbers were missing. These are in their places, and the others will come up if needed. The series has never in any way bothered me by standing out in its entirety, or by any inability to get rid of the numbers. It never interferes with my attention. It has never been any source of wonder to me, always seeming perfectly natural. I have a faint impression of thinking about it, or being conscious of it four years ago. I may have come across something like it in my reading. I have never attempted to analyze it in any way. The last few days have tended to make the plan clearer, and I have learned many things about it (the subject being a member of a class in psychology). Should a number less than one hundred fail to appear in its place when I am thinking of

it, I should feel much surprised. It is perfectly agreeable to me to have this form."

"I can always see it better with my eyes shut. If I try to picture it and cannot get the relations right, I close my eyes and then I can get the detail very readily. I dream a great deal, but I do not remember that the form has ever appeared in my dreams. I also find it impossible to construct any image and place it between the numbers and myself. I do not have much trouble in getting images of things, except that when reading descriptions of places in books, I cannot see the places."

Within four months after the above descriptions were given, the subject discovered that it was possible to enlarge and to contract the form at will. In either instance of change, the proportions of the geometrical relations did not vary. No dream experience in the interval which involved the form was reported.

II. THE DAY FORM.

In addition to the form for numbers, this subject has a three-dimensional form into which the days of the week are placed. This is a relatively simple form, lies near in front and extends to the left. The time direction is from right to left. It starts with Sunday, which is always the first day of the form (see diagram III), close to the mental point of regard. This day is to the right, and nearly on a level with the eye, but must be looked up to slightly. Monday is to the left of the direct line of vision, "quite a space above, and a little higher than Sunday." Monday is the highest day of the week. Tuesday is about as far beyond Monday as the latter is distant from Sunday, but "goes below Sunday." Wednesday descends slightly, while Thursday ascends "a little bit higher than Wednesday." Friday "is very low down, being the lowest day." Friday evening is the lowest part of the week. "A straight line connecting the evening and morning of Friday, if continued, would pass through the point of regard." Saturday "rises from Friday up towards the *next* Sunday," which is not quite so high as the first Sunday.

This form is always of "the present week." It can be repeated for one or two weeks in the future, when it is projected farther to the left, until it becomes dim and fades away. One or two weeks just past can be arranged, or "thought of," in the same form, when they are added on towards the right of the Sunday with which the series begins. The past days begin to fade away at the end of one or two weeks. The present week is the staple and recurrent form.

The names of the days of the week appear in print, as it were, filling spaces lying at right angles to the time-line, which

marks the general forward direction from right to left. These names appear as "dark spaces," with but little illumination, and no coloring. As in the case of numbers, they seem to be parallelograms of uniform dimensions. The days seem to be distinct from the nights, the latter being represented by the darker spaces between the former, which are equal throughout the form. The forenoon of a day is usually "seen" as either the nearer portion of the *time*-line occupied by that day, or by the portion of the *day*-line below the time-line. The afternoon is "seen" as either the portion of the time-line to the left of the day-line, or the upper half of the day-line itself. The subject has no preferences among the days.

An interesting fact connected with this form is, that, while the names of the days were known ("learned") before the subject could read, it never occurred to the person that use was being made of this form until the Sunday before the statement of these descriptions, in August, 1899. On that day the report ran thus: "I wondered how I would look on Wednesday (that is, how Wednesday would appear); but I had to wait until Wednesday actually came." It became a new experience to get the days "all together," and to connect the facts. This implies that the visualization had a definite dependence upon the actual perception of time as filled in with the associative aid of the name given to a particular portion of time.

III. THE MONTH FORM.

The months comprising the current calendar year are arranged by the subject into a form, which is distinct from the form for the days. In relation to the latter, the month form is "located" farther away from the mental point of regard, and in a position more nearly at right angles to the line of vision (see diagrams II and III). This form also is tri-dimensional. "The months seem to rise to the left. January is farther away than the days of the week, and a little below the horizontal plane passing through the point of regard. February is higher, and March is still higher, April descends, while May is the highest month in the entire year. June, July, and August are each a little lower than its predecessor. September, October, and November ascend, in each instance, slightly above its predecessor, while December goes down toward the next January. At New Year's the form starts anew." The spaces between the months seem equal. "August, the present month, is seen permanently to the left."

The name of each month does not seem to lie at right angles to the time-line. The time direction, as in the day form, is towards the left. "The first few letters of the name of the month seem to cover the first few days of the month, but

tending towards the right, the remaining letters swing off to towards the right of the time direction, while time moves to the left." In the case of the longer names, it is usually the ordinary abbreviation of each name which appears, such as "Jan.," "Sept." The shorter names appear in full.

This form is always of "the present year." The months of the past year can be localized by special effort. "A year ago this month is localized by stepping back from the January of the form to December, November, and so on, to August, towards the right. This process can be continued for about a year previous to the first January, when fading takes place." The next year can be constructed in a similar manner, *mutatis mutandis*, by beginning with December and proceeding to the right.

The subject has preferences for some of the months and aversions towards others. May seems especially agreeable, while December is not liked in the least (that is, the months in the form). There is "always a feeling of relief when December has passed." These associations are regarded by the subject as due probably to later experiences, derived from reading and observation.

It should be noted that the direction of time in the day and month forms moves from right to left, conforming to the general group direction assumed by the number form, instead of from left to right, the usual way of placing successive days and months in an occidental calendar, for example.

IV. CHARACTERISTICS OF THE SUBJECT.

The following biographical data are added for such light as might be thrown upon the genesis of these three forms of visualization. The subject possessing these forms is an unmarried woman, thirty-five years of age at the time of the first descriptions. She was born in Hamilton, Ontario, being the seventh child in order of birth in a family of twelve children, whose parents were natives of Ireland. Four children died in infancy. The father had been a school teacher before immigrating to America. Her home was in a country district until her ninth year. Her playmates were her brothers and sisters and a few children from the neighboring farms. As a child she "was always shy and timid, committing many childish misdeeds, and always afraid of punishment." No early experience of fright or strain in early years stands out distinctly in memory. She was delicate in health until the age of ten, but does not recall any special illness at any time; there was no marked trouble with her eyes in childhood. Since her fourteenth year her right eye has been astigmatic, and the left eye myopic, both defects having been corrected by wearing proper glasses during the last few years.

The subject first attended school about three months before the ninth year of age. "I was noted in those times for having a good memory. They never said anything about the meaning of words, and I had great trouble in learning words at school; but I could always get my arithmetic lessons." She liked number work, especially when a child, "better than anything else," because she had the satisfaction of having this work right in contrast with language exercises. She learned to read very rapidly, covering the first, second, and third readers in one year. Writing was first taught her in the ninth year, but she was able to make figures long before she could write, or read writing.

The number series is remembered distinctly as fully formed at the age of eight years. The multiplication tables were learned at that time, but the ability to count was acquired at a very much earlier age. The older children of the family were taught at home, and she recalls overhearing her brothers at their work. Thus she became able to count to one hundred before the eighth year. There is no memory of being taught to count (except the drill work in class, where the exercise consisted merely of the repetition of the names of the numbers), but there is a memory of having learned to count before the sixth year. The acquisition of the multiplication table is distinctly remembered. The table was printed, as usual then, in full in the text-book. At that time the numbers, when thought of, were placed in the proper spaces in the number series. In multiplying two by two, four was always thought of as now, the thought being of the product and not of the factors. The subject has experienced no particular liking or disliking for special numbers, except three, which was once made with a distinct pleasure. The formation of the figure 3 was very difficult until the age of fourteen, when the ability to make the figure was acquired by diligent and assiduous practice.

The names of the days of the week were learned *previous* to learning to read. The names of the months were first known *after* having learned to read. The scheme for the months is remembered as having been acquired later than the scheme for the days. (This fact does not essentially discredit the report above, that the form for the days was not fully thought over until the time of special description.) In motor abilities, there is no disposition on the part of the subject to be left-handed. This fact may have some negative significance with reference to the feature of all the forms to proceed to the left. It was also ascertained that two of her senior brothers possessed number forms. No details of the elder's form were known; the younger's number form was known merely as being much more complex than the one possessed by the subject.